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Evaluation of Class A Aggregate Base Course Compaction Quality Using the Sand Cone Test in a Road Preservation Project

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ABSTRACT

Class A aggregate base course is a vital component of pavement structures that functions to distribute traffic loads to the underlying layers. Its performance is largely determined by the level of compaction achieved during construction. This study aimed to evaluate the compaction quality of the Class A aggregate base course using the Sand Cone method and to assess its compliance with the *Bina Marga* General Specifications. A descriptive quantitative approach was employed through Sand Cone testing at 10 sampling points on the Road Preservation Project, Taba Mulan–Simpang Nangka Section, Bengkulu Province. The degree of compaction was determined by comparing the field dry density with the maximum dry density obtained from the Modified Proctor test (2.23 g/cm³). The results showed that the field compaction ranged from 99.10% to 101.79%, with an average of 100.49%. Eight testing points (80%) met the minimum compaction requirement of 100% Modified Proctor, while two points (20%) did not satisfy the specification. Overall, the Class A aggregate base course complied with the technical requirements of the *Bina Marga* General Specifications. Variations in compaction were influenced by material moisture content, layer thickness, the number of roller passes, aggregate gradation, weather conditions, and quality control during construction. Therefore, continuous supervision and quality control are essential to ensure that all sections achieve the required technical specifications.

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INTRODUCTION

Road infrastructure plays a vital role in supporting community mobility and regional economic growth; therefore, its construction and preservation must comply with applicable technical specifications (Simanjuntak & Munizar, 2017). One of the key components of pavement structures is the Class A aggregate base course, which functions to distribute traffic loads to the underlying layers. The performance of this layer is highly dependent on the degree of compaction achieved during construction. Inadequate compaction can reduce the pavement's load-bearing capacity and lead to settlement, permanent deformation, cracking, and premature pavement failure. Quality control is commonly carried out using the Sand Cone method, which determines the field dry density of the material and compares it with the maximum dry density obtained from the Modified Proctor test to determine the degree of compaction.

This study was conducted on a road preservation project to evaluate the compaction quality of the Class A aggregate base course and its compliance with the *Bina Marga* General Specifications. The evaluation was performed through Sand Cone testing at several sampling points, and the results were compared with the laboratory maximum dry density to determine the degree of compaction. In addition to assessing compliance with the technical specifications, this study also identified factors influencing compaction performance, including moisture content, aggregate gradation, layer thickness, the number of roller passes, weather conditions, and quality control during construction. The findings are expected to provide valuable input for improving the quality of construction practices and quality assurance in road projects.

METHODS

This study was conducted to determine whether the compaction of the Class A aggregate base course achieved in the field complied with the technical requirements specified in the 2018 Bina Marga General Specifications. The findings are expected to serve as an evaluation of the quality of road construction work, particularly for the compaction of the Class A aggregate base course.

The research was carried out on a road preservation project, focusing on the construction of the Class A aggregate base course. The study site was selected because it is part of a national road preservation project involving road rehabilitation and maintenance, where strict quality control of the compacted aggregate base course is essential.

Sand Cone tests were conducted at several representative locations to reflect the actual field conditions. The selection of testing points was based on (1) site conditions, (2) completed compacted areas, (3) work sections that met the requirements for testing, and (4) recommendations from the field supervisor. The research was conducted during the implementation of the Class A aggregate base course works in 2026. The research stages included preparation, literature review, project data collection, field observations, Sand Cone testing, data processing, result analysis, and preparation of the research report.

This study employed a descriptive quantitative research approach. The quantitative approach was used because the data consisted of numerical values obtained from field density tests, while the descriptive approach was applied to describe the compaction condition of the Class A aggregate base course based on the Sand Cone test results. The objectives of this study were to: (1) determine the field density of the Class A aggregate base course, (2) compare the test results with the requirements of the 2018 Bina Marga General Specifications, and (3) evaluate the quality of compaction work performed in the field.

RESULTS AND DISCUSSION

Based on the results of the Sand Cone tests conducted on the Class A aggregate base course in the Road Preservation Project, 8 out of 10 testing points (80%) satisfied the minimum compaction requirement of 100% Modified Proctor, while 2 testing points (20%) failed to meet the specification, namely at STA 0+300 with a compaction value of 99.55% and STA 0+900 with a compaction value of 99.10%. Based on these findings, the following recommendations are proposed.

1. Corrective Measures for Non-Compliant Locations

For testing points where the compaction value is below the required standard, recompaction should be carried out before the placement of the subsequent pavement layer. Recompaction should only be performed after verifying the material's moisture content. If the moisture content is lower or higher than the optimum moisture content determined by the Modified Proctor test, it should first be adjusted by either adding water or allowing the material to dry until the optimum condition is achieved. The material should then be recompacted using the specified number of roller passes, followed by a repeat Sand Cone test to confirm compliance with the required compaction specification.

2. Improvement of Field Quality Control

To minimize non-compliant compaction results in future works, contractors should strengthen the field quality control (QC) system throughout the construction process. Quality control measures should include routine inspection of material moisture content before compaction, monitoring of aggregate layer thickness, and verification of the number of roller passes for each work section. More stringent supervision will reduce variability in compaction results and improve the consistency of construction quality.

Moisture content inspection is one of the most critical aspects of compaction quality control. The moisture content should be maintained at or near the Optimum Moisture Content (OMC) determined from the Modified Proctor test. If the moisture content is too low, aggregate particles cannot be compacted efficiently, resulting in lower field density. Conversely, excessive moisture fills the voids between particles, reducing the effectiveness of compaction energy and lowering the achieved density. Therefore, moisture content should always be checked before compaction to ensure that the Maximum Dry Density (MDD) specified in the technical standards can be achieved.

3. Optimization of Compaction Equipment

The success of the compaction process is strongly influenced by the type of compaction equipment (Vibratory Roller), roller weight, rolling pattern, and the number of passes. Therefore, equipment operators should ensure that compaction is performed in accordance with the established construction procedures. If field test results indicate insufficient compaction, the number of roller passes should be increased gradually until the required density is achieved without causing damage to the aggregate structure.

4. Moisture Content Control

Moisture content is one of the primary factors affecting the compaction quality of the Class A aggregate base course. Before compaction, the material should be tested to ensure that its moisture content is close to the Optimum Moisture Content (OMC) of 12%, as determined by the Modified Proctor test. Materials that are too dry should be uniformly watered, while excessively wet materials should be allowed to dry before compaction. Proper moisture control enhances compaction efficiency and facilitates the achievement of maximum density.

5. Periodic Aggregate Gradation Testing

In addition to moisture content, aggregate gradation significantly affects compaction performance. Aggregate materials with gradation conforming to the specification provide better particle interlocking and enable higher compaction levels. Therefore, periodic gradation testing should be carried out to ensure continuous compliance with the Bina Marga General Specifications throughout the project.

6. Increasing the Frequency of Field Testing

Sand Cone testing should not be limited to the minimum number of testing locations required by the specification. Additional tests should be conducted at critical locations or areas showing indications of inadequate compaction. Increasing the frequency of field testing enables early detection of quality deficiencies, allowing corrective measures to be implemented before subsequent construction activities proceed.

7. Coordination Between the Contractor and Supervising Consultant

Effective quality control depends not only on field implementation but also on close coordination between the contractor and the supervising consultant. The results of every Sand Cone test should be jointly reviewed. If any testing point fails to meet the specification, recompaction should be performed before the next pavement layer is constructed. Good coordination minimizes the risk of rework during subsequent construction stages.

8. General Recommendations

Based on the results of this study, the Class A aggregate base course constructed in the Road Preservation Project, generally satisfies the technical requirements, with an average compaction value of 100.49%. Nevertheless, to ensure overall construction quality, all testing points should achieve a minimum compaction level of 100% Modified Proctor. Consistent implementation of quality control, beginning with material selection, moisture content adjustment, layer placement, compaction, and field density testing, will improve road construction quality, extend pavement service life, and reduce the risk of premature pavement deterioration and future maintenance costs.

CONCLUSION

Based on the findings of this study entitled "Evaluation of Class A Aggregate Base Course Compaction Using the Sand Cone Method in the Nakau–South Sumatra Border Road Preservation Project, Bengkulu Province (Taba Mulan–Simpang Nangka Section)," the following conclusions can be drawn:

1. The Sand Cone test results indicate that the field compaction of the Class A aggregate base course ranged from 99.10% to 101.79% of the maximum dry density obtained from the Modified Proctor test (2.23 g/cm³), with an average compaction value of 100.49%. Of the 10 testing points, 8 points (80%) achieved compaction values of 100% or greater, satisfying the minimum compaction requirement, while 2 points (20%) recorded values below 100%, namely 99.55% at STA 0+300 and 99.10% at STA 0+900. These results indicate that, overall, the Class A aggregate base course achieved satisfactory compaction quality and provided adequate structural support for the overlying pavement layers.
2. The evaluation based on the 2018 Bina Marga General Specifications shows that the compaction work generally complied with the required technical standards, as the average field compaction exceeded the minimum requirement of 100% Modified Proctor and most testing points met the specification. However, the two non-compliant locations require recompaction before the placement of the subsequent pavement layer. Variations in compaction among the testing points were influenced by several field factors, including material moisture content, aggregate layer thickness, the number of roller passes, aggregate gradation, weather conditions during compaction, and the effectiveness of construction quality supervision. Therefore, consistent quality control through proper moisture content management, monitoring of layer thickness, optimization of roller passes, and periodic Sand Cone testing is essential to ensure that all sections of the Class A aggregate base course comply with the technical specifications and provide optimum pavement performance throughout the intended service life.

REFERENCES

Bowles, J. E. 1991. *Sifat-Sifat Fisis dan Geoteknis Tanah*. Jakarta: Erlangga.

Das, B. M. 1995. *Mekanika Tanah (Prinsip-Prinsip Rekayasa Geoteknis)*. Jakarta: Erlangga.

Direktorat Jenderal Bina Marga. 2018. *Spesifikasi Umum Bina Marga 2018*. Jakarta: Kementerian Pekerjaan Umum dan Perumahan Rakyat.

ASTM D1556. 2007. *Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method*. ASTM International.

Undang-Undang Republik Indonesia Nomor 38 Tahun 2004 tentang Jalan.

Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat tentang Penyelenggaraan Jalan.

Direktorat Jenderal Bina Marga. 2018. *Spesifikasi Umum Bina Marga 2018*. Jakarta: Kementerian Pekerjaan Umum dan Perumahan Rakyat.

Hidayat, A. 2023. *Pengendalian Mutu Pemadatan Lapis Pondasi Agregat Kelas A Menggunakan Metode Sand Cone*. Jurnal Teknik Sipil Indonesia, 8(2), 45–53.

Simanjuntak, M. R. A., & Munizar, R. (2017). Preliminary Study of Optimization Model of Local Government Infrastructure Asset Management to Improving the Sustainable Development Performance. *International Journal of Scientific and Research Publications*, *7*(12), 588-597.